A different attitude about stall awareness and avoidance - a reprint of the June 2016 *Sport Aviation* article

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Very early on in our pilot training we were all introduced to stalls. Instructors do their best to reassure the new pilot that there's nothing to worry about. Stalls aren't scary, and there is no reason to be afraid.

I understand why every pilot must be aware of the risk of flying too slowly. And I know that the out-of-control falling feeling of a full stall can be scary to a new pilot. But are we doing the right thing by minimizing the danger of stalls during pilot training?

The accident record says no; we're not getting it right when it comes to stall training and awareness in personal airplanes. Loss of control is the most frequent cause of serious and fatal accidents, and an unintended stall is the most common cause of the loss of control.

If there is a number one risk in personal flying, it is clearly an unintended stall at low altitude. Instead of reassuring student pilots that there is nothing to be afraid of during a stall, maybe we should be saying be very afraid. A stall can kill you quickly, and often there is no chance to recover from an unintentional stall at low altitude no matter how skilled, experienced, or well-trained the pilot may be.

Now let's compare the attitude and training around stalls in general aviation to how stalls and stall awareness are handled in jets and other large airplanes.

Unintended stalls are extremely rare in jets. I know, I know, you're screaming at the page about those guys in the Airbus over the Atlantic in the dead of night in an area of thunderstorms who lost all of their instruments, stalled the airplane at high altitude, and crashed. That Air France accident happened seven years ago. Think of the millions of hours of jet fights since with no similar accidents.

And, yes, a couple years ago a Boeing 777 crew terribly mismanaged the power on approach to landing in San Francisco and stalled onto the runway. And in the past two years a single pilot failed to maintain airspeed in a Phenom business jet, stalled, and crashed. Jet pilots do very occasionally stall the airplane, but we are talking about years and millions of hours of flying between accidents. No matter how you slice it, jet and large airplane pilots are doing way, way better at avoiding stalls and subsequent loss of control than GA pilots.

I have a theory about why jet pilots are so much better at avoiding the stall accident. It's simple—when you fly a jet or large airplane you have the fear of God put into you about stalls and slow flying from day one.

The essential motivation for jet pilots to avoid stalls is the requirement for minus zero airspeed below VREF tolerance. It's the only operating airspeed I can think of that gives pilots of large airplanes airspeed with zero tolerance.

If you fly too slowly on your initial checkride, you fail. You can fly 10 knots faster than VREF and be okay, but if you get a knot too slow on the annual recurrent check required of type-rated pilots, you fail. This is real motivation. A jet pilot may not believe he's going to die if he busts the minimum airspeed, but he knows his certificate and his career are on the line. And there is a recorder hidden somewhere in the tail of the airplane keeping track of his airspeed on every fight so if something goes wrong and he busted the zero tolerance, it's impossible to hide.

The one-turn spin rule has ancient roots from a time when post-stall behavior was not as well understood and predictable and airplanes really did spin in from a recoverable altitude. But the unintended result of the one-turn requirement is that at least some stall avoidance and stall alerting is sacrificed.

In other words, jet pilots aren't patted on the back and told not to be afraid of stalls. It's the reverse. You are told in no uncertain terms that going too near a stall can be a career ender.

The minus zero airspeed tolerance applies to VREF, which is the landing approach reference airspeed. VREF is 1.3 times the indicated stalling airspeed, providing a 30 percent safety margin above stall.

VREF, of course, varies by aircraft weight, configuration, and maneuvering load on the wing. Those are the factors that affect stall speed. So the pilot must know the actual weight of the airplane to look up VREF. The airspeed is then adjusted upward if the airplane is not yet in landing configuration. For example, the minimum airspeed is typically VREF plus 20 knots, or something like that, for approach flaps only. And the actual final approach VREF applies only in stable fight with bank angles of less than 15 degrees.

All jets and large airplanes have bugs on the airspeed to mark the calculated VREF. Pilots look up VREF for their weight and "bug" the airspeed before terminal area maneuvering. More commonly these days the fight management system calculates VREF because it knows aircraft weight.

Some operators will set the VREF bug at the higher values proscribed for maneuvering and for less than full flaps. Some use multiple bugs. And others simply remember to add the assigned minimum airspeed value until on final approach.

What this whole worship of VREF does is demand constant awareness of what the stalling airspeed is, and that you are always flying at a safety margin above stall. The pilot who is not flying calls out airspeeds as a margin above VREF. He also alerts the pilot who is flying if the airspeed is degrading toward VREF. The constant awareness of VREF and its vital nature creates a culture of airspeed awareness that I just don't see in light airplane flying.

Of course jet pilots must practice stalls during initial and recurrent training, but that, too, is different from the way stall training is typically done in GA. In jets pilots fly a clean approach and departure/ turning "stall." But you never really stall. As soon as the stall warning activates—a stick shaker, an aural warning, flashing lights, or all three—the jet pilot must immediately perform the normal recovery actions by adding power, lowering the nose, and rolling the wings level. The airplane never actually stalls, and if it did, the pilot would certainly funk that check.

The fact is that many jets, especially the models with highly swept wings, have very dicey post-stall behavior and may not be recoverable under all conditions. That's why the majority of jets have automatic stick pushers that automatically jam the controls forward to prevent an actual aerodynamic stall. Some jets with aft-mounted

Engines and T-tails can have a deep stall mode where the nacelles disrupt airflow to the horizontal tail at high angles of attack so the elevator has no effectiveness to lower the nose and break the stall. A true deep stall is almost certainly unrecoverable without the "spin chute" used during experimental fight testing.

In the simulator pilots often fly the airplane to the stick pusher during training just to see what it would be like in real life. Gulfstream offers an advanced course that replicates the maneuvers production test pilots perform on airplanes of the assembly line, and that includes flying to the stick pusher at high altitude. I flew that course and can tell you the nose-down attitude the pusher creates is dramatic with an excellent view of the Atlantic. And you must remain pointed at the ocean for a long time before the airplane accelerates enough for a pullout that doesn't create a secondary stall.

While aircraft certification and pilot training in large airplanes has demanded stall avoidance, we have done the opposite in light airplanes where the requirements are for certain post-stall behavior. In jets we demand the airplane not be stalled, but in personal airplanes we expect them to stall. Are we getting what we expect?

The certification mantras in single-engine airplanes have been a maximum stalling speed of 61 knots and recovery from a one-turn spin in one additional rotation. The 61 knot stall speed cap makes sense because it limits the energy that must be absorbed in a forced landing. That odd number came about because the original rule was expressed as 70 mph.

The one-turn spin rule has ancient roots from a time when post-stall behavior was not as well understood and predictable and airplanes really did spin in from a recoverable altitude. But the unintended result of the one-turn requirement is that at least some stall avoidance and stall alerting is sacrificed. The reality is an airplane that recovers quickly from a spin as the rules require also is more likely to enter a spin. A design that resists rolling of in a stall can also develop unwanted behavior when abused during the 360-degree stalled turn the rules demand.

I'm happy to say that the FAA has released its proposed new certification standards for "small" airplanes under FAR Part 23, and in the preamble the FAA regulators say the new emphasis will be on stall alerting and avoidance. They acknowledge that the one-turn spin requirement is not effective in accident prevention because unintentional stalls happen at too low an altitude for recovery no matter what the spin characteristics may be.

I think this is tremendous progress. Finally, the FAA has examined real flying and sees that we have one group—jet pilots—who virtually never have stall accidents even though they fly airplanes with often vicious stall characteristics. On the other hand, we have pilots flying airplanes with specific stall behavior requirements, and unintended stalls and resultant loss of control is the largest cause of fatal accidents.

What's the secret? Absolute unintentional stall avoidance. The jet pilot starts his training with the knowledge that if he gets even within 25 percent of actual stall speed, he funks. The new light airplane pilot is told not to worry; stalls are no big deal. To me it's obvious which group has it correct.

Angle of attack indicators and other stall warning devices can help in light airplanes, but the culture of VREF can help even more, and more quickly. If every pilot always knew VREF, bugged it on the airspeed, and never went below that airspeed without certainty of failing every check, unintentional stalls could become as rare as they